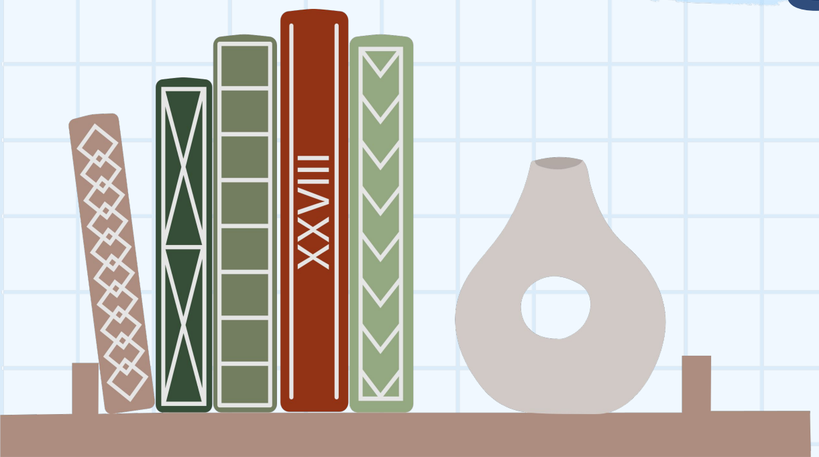
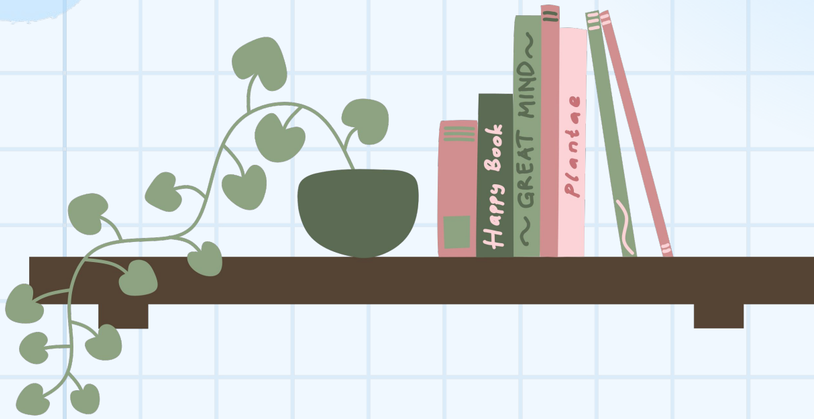
BS./BSC.

Applied AI and Data Science

Algorithmic Thinking & its Applications





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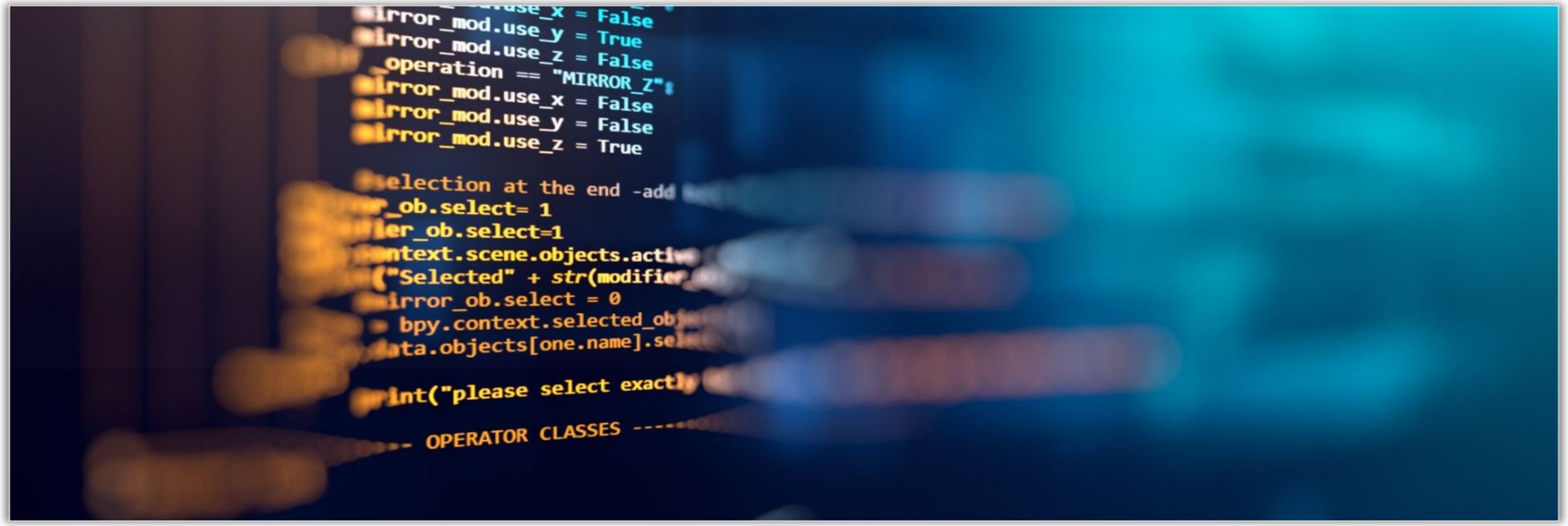


Why learn to program?

Slide Credits : Cornell University

Why learn to program?

(subtly distinct from, although a core part of, CS & IS)

Computing is worth teaching less for the subject matter itself and more **for the habits of mind that studying it encourages.**

"Teach computing, not Word", the Economist
http://www.economist.com/blogs/babbage/2010/08/computing_schools

Why learn to program (continued)

[T]he seductive intellectual core of… programming: here is a magic black box. [T]ell it to do whatever you want, within a certain set of rules, and it will do it;

… within the confines of the box you are more or less God, your powers limited only by your imagination.

But the price of that power is strict discipline: you have to *really know* what you want, and you have to be able to express it clearly in a formal, structured way

that leaves no room for the fuzzy thinking and ambiguity found everywhere else in life…

Getting started with Python

Why Python?

Low overhead

- Little to learn before you start “doing”
- Easier for beginners
- Designed with “rapid prototyping” in mind

Highly relevant to non-CS majors

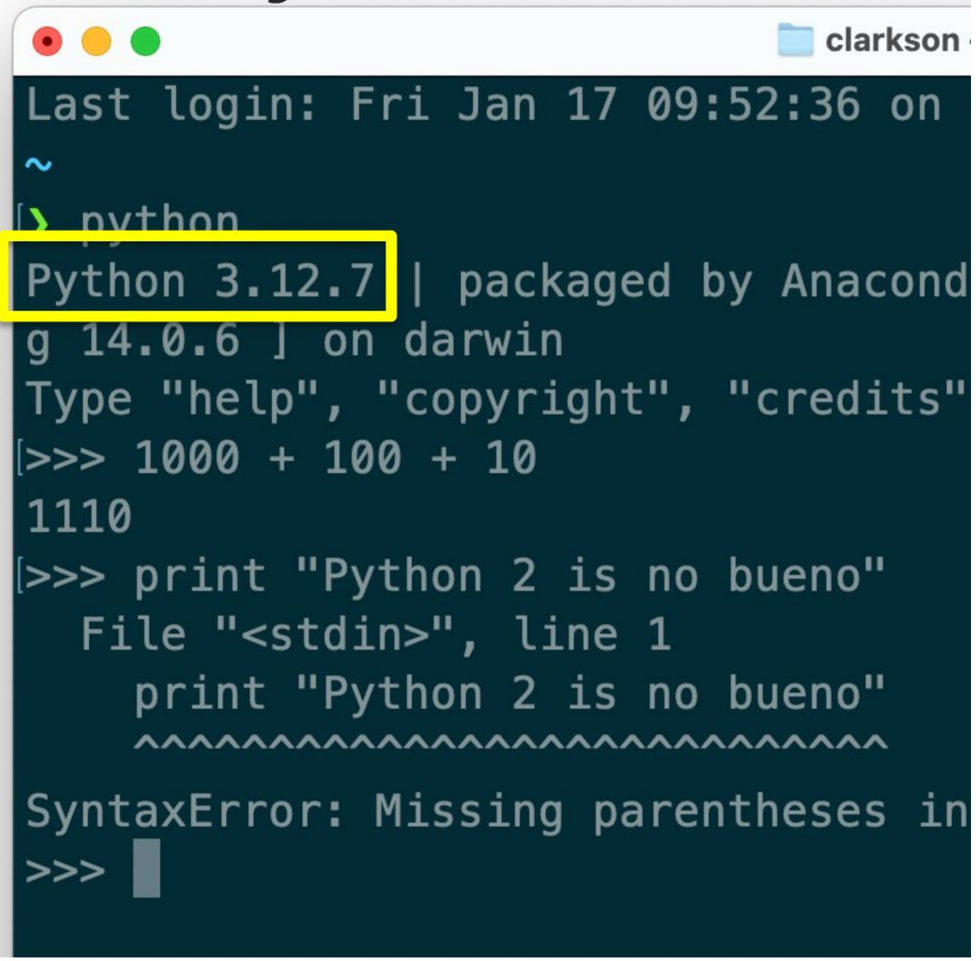
- NumPy and SciPy heavily used by scientists

A modern language

- Popular for web applications (e.g. Facebook apps)
- Applicable to mobile app development

Getting Started with Python

- Designed to be used from the “command line”
  - OS X/Linux: **Terminal**
  - Windows: **PowerShell**
    - Preferred over **cmd**
  - Purpose of the first lab
- Install, then type “python”
  - Starts the *interactive mode*
  - Type commands at >>>
- Quit by typing quit() then pressing Return



This class uses **Python 3**
- Make sure you are, too!

```
>>> terminal time >>>
```

Expressions

An expression **represents** something

- Python ***evaluates it*** (turns it into a value)
- Similar to a calculator

Examples:

- `2.3`

- `(3 * 7 + 2) * 0.1`

Storing and Computing Data

What data might we want to work with?
(What's on your computer?)

42

$3.0 * 10^8$

0.00001

14850

"apple"

"Tower Road"

"ewe2"

True

False

Types

A set of values & operations on these values

- Examples of operations: +, –
- Meaning of operations depends on type

Memorize this definition!

How to tell the Type of a Value

Command: type(*value*)

Example:

```
>>> type(2.0)
<class 'float'>
```

```
>>> terminal time >>>
```

Type: **float** (floating point)

Values: (approximations of) real numbers

- With a ".": a **float** (*e.g.*, 2.0)
- [Without a decimal: an **int** (*e.g.*, 2)]

Operations: +, −, *, /, **, //, %

division

floor division

multiplication

exponentiation

remainder (modulo)

```
>>> terminal time >>>
```

Floating Point Errors

Python cannot store most real numbers exactly

- Similar to problem of writing 1/3 with decimals

Approximation results in **representation error**

- When combined in expressions, error can get worse
- **Example**: `0.1 + 0.2`

```
>>> terminal time >>>
```

Type: `int` (integers)

Values: …, –3, –2, –1, 0, 1, 2, 3, 4, 5, …

More Examples: `1`, `45`, `43028030`

(no commas or periods)

Operations: +, –, *, **, /, //, %

floor division (produces an int)

division (produces a float)

multiplication

exponentiation

remainder (modulo)

Note: operator meaning can change from type to type

```
>>> terminal time >>>
```

Type: **bool** (boolean)

Values: True, False (must be capitalized)

Often come from comparing **int** or **float** values

- Order comparison: `i < j` `i <= j` `i >= j` `i > j`
- Equality, inequality: `i == j` `i != j`

"=" means something else!

Operations: (comparisons above), not, and, or

- not b: **True** if b is false and **False** if b is true
- b and c: **True** if both b and c are true; **False** otherwise
- b or c: **True** if b is true or c is true; **False** otherwise

```
>>> terminal time >>>
```

Boolean Misconceptions

Booleans expressions *sound like* English, but subtle differences cause problems:

- In English, "A or B" often means "A or B ***but not both***"

  Example: "I'll take CS 1110 or CS 1112" (but not both)

  In Python, "A or B" always means "A or B ***or both***"

- In English, "A = B and C" often means "A = B and A = C"
  Example: "Ithaca is cold and snowy"
  - Means: "Ithaca is cold" and "Ithaca is snowy"
  - **Does not mean**: "Ithaca is cold" and…. "snowy"

Type: **str** (string) for text

Values: any sequence of characters

Operation(s): **+** (catenation, or concatenation)

Again: operator **+** changes from type to type

String: sequence of characters in quotes

- Double quotes: `" abcex3$g<&"` or `"Hello World!"`
- Single quotes: `'Hello World!'`

Concatenation applies only to strings

- `"ab" + "cd"` evaluates to `"abcd"`
- `"ab" + 2` produces an **error**

```
>>> terminal time >>>
```

A

type…

A. is a set of values & operations on these values
B. represents something
C. can be determined by using `type()` in Python
D. can be changed by using `type()` in Python
E. determines the meaning of an operator

If there are multiple true answers, pick the best definition.

A

type…

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Thank you

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